# CAETS

International Council of Academies of Engineering and Technological Sciences

# Sustainable Food Systems – Toward Food for All

## A CAETS Symposium Statement

### Copenhagen, Denmark, June 29-30, 2010

The 31st Annual Meeting of the International Council of Academies of Engineering and Technological Sciences (CAETS) took place in Copenhagen, Denmark, June 29-30, 2010. A symposium held June 29 focused on how to achieve a sustainable global food system, which allows increased food production while reducing poverty and hunger and over-exploitation of natural resources. It was noted that past advances in food production, obtained in part by over-exploitation of natural resources, as more land was brought into agriculture and new fish stocks were exploited, must be avoided. Achieving sustainable management of natural resources while meeting increasing future food demands was recognized as the key to success.

The conference rejected the notion that efforts to assure food security for all must necessarily be at the expense of the environment. While the continuing need to develop new technologies, particularly in recognition of the vulnerability of food security to global climate change, should not be underestimated, some of the solutions to achieve a sustainable food system are available through regional adaptation and utilization of technologies already developed. Progress toward food security today can be facilitated today by adoption of economically and politically feasible government interventions, for example, to provide access to available technologies to indigent farmers.

Achievement of a sustainable food system will require ***reform of the food production system, modernizing the food processing chain, and implementation of policy and market reforms and appropriate economic incentives.*** To achieve these goals, the CAETS Council recommends seven actions as enumerated below. These recommendations are based on the views of the speakers and participants, including attendees from member academies, at June 29 Symposium.

CAETS is the International Council of Academies of Engineering and Technological Sciences, Inc. It consists of those national academies of engineering and technological sciences that have satisfied an agreed set of criteria for membership. It was established in 1978 and was incorporated as a charitable non-profit corporation in the District of Columbia (US) in 2000. Its Articles of Incorporation, Bylaws and Operating Procedures set down its objectives and governance arrangements. These documents and its membership and achievements are posted on the CAETS website, www.caets.org.

## RECOMMENDATIONS

### 1. Use available technologies

Conventional farming is becoming significantly more sustainable. Modern genetic techniques and better understanding of crop physiology allow for a more directed approach to selection across multiple traits. The speed and costs at which genomes can now be sequenced or re-sequenced means that these techniques can be more easily applied, in combination with more traditional plant breeding technologies, to develop varieties of crop species that will yield well in challenging environments. There is a need to keep focus on how to develop crops that can survive a flood or monsoon, resist pests, new diseases and more difficult weather and, at the same time, provide higher yields on the same land. A continuous and vigorous science-based search to increase productivity, especially focused on the needs of small farms in the developing world, is necessary to secure food for all. Genetic modification should be pursued according to international protocols and the outcomes should neither be available to only the privileged nor automatically dismissed as unsafe. Both public and private investment in research should be expanded to assure productivity increases that are compatible with sustainable management of natural resources and reduced release of green house gasses. New alliances must be forged between businesses, society, organizations and government.

**CAETS recommends expanded public and private investments in agricultural research and technology transfer to enhance productivity, assure sustainable management of natural resources, and prepare for climate change on small farms in developing countries; that full advantage should be taken of emerging technologies to develop new crop varieties with full respect for biodiversity, the environment, and health; that these technologies should be made available to the small farmers who need them at prices which allow for a free choice among different options; and that essential weather, climate and other environmental information be more widely available to the farming community.**

### 2. Save energy

The food industry is highly dependent on energy for food preservation, safe and convenient packaging, storage and distribution. Approximately half of all energy end-use consumption is used to change raw materials into products (process use) through heating, dehydration, refrigeration, machine drives and electro-chemical processes, among others. There are numerous opportunities for food engineers and agricultural scientists to contribute to energy efficiency throughout the food chain. Changes made to improve quality or safety often results in energy savings. Potential economic advantages and environmental benefits exist in waste and water efficiency improvements. Making the food chain more efficient can also be achieved through a reduction of losses and wastage, serving the interests of farmers, consumers and society at large. These contributions can be achieved through application of new technologies and by using appropriate scale technologies.

**CAETS recommends efforts to enhance energy efficiency in the food industry through voluntary process analysis and improvement and adoption of effective governmental energy policies; that future energy efficiency studies should focus on improving existing plants and developing more energy-efficient food processing and post-harvest storage and distribution technologies; and improved education of consumers in handling and preserving food to minimize food spoilage and waste.**

### 3. Expand aquaculture

The global catch of wild fish has been at approximately the same level for the last two decades. Half of the fish stocks are fully exploited and more than one third is overexploited. The production of fish by aquaculture has to be doubled during the next 30 years to compensate for a growing population. Marine aquaculture holds a large potential for sustained growth if the food needed for marine animals can itself be derived from marine aquaculture, rather than harvested from the wild or derived from agriculture. This would include animals lower in the food chain, such as plankton and algae, which could be used as food for humans as well as fish. Marine plant oils and proteins could be utilized as ingredients for feed in the aquaculture industry. Environmental impacts from the expansion of marine aquaculture can be reduced through proper modelling of the marine ecosystem. These impacts will be modest compared to those resulting from food production on land where lack of water for food production will be a limiting factor. However, it will be important to take a more strategic approach to site location and capacity within catchments or coastal zone management units. Negative environmental impacts from overfishing and use of damaging fishing techniques in marine areas and coral reefs must be discontinued.

**CAETS recommends that marine aquaculture should be improved and expanded, taking into account the use of responsible farming; that fish caught at sea must be human food; and that stock selection be improved, large scale production technologies be adopted and aquaculture in open seas and larger inland bodies be developed.**

### 4. Improve packaging and distribution

Packaging is sometimes considered to be undesired waste appearing when the food has been consumed. However, a package's most important property is to protect a product throughout a chain of logistics, so that it reaches the consumer in a good state. Regardless of material, packaging contributes to sustainability in terms of minimizing food waste, but different sustainability aspects must be considered along the value chain from forestry through material production, packaging manufacture, filling, distribution, and consumption to end-of-life handling. Packaging's and distribution's contributions to economic, environmental and social sustainability can be illustrated by the fact that in developing countries inadequate packaging and distribution results in a very high percentage of all food produced never reaching the final consumer. This compares with very low losses in developed countries. Investment in infrastructure to

facilitate effective and efficient domestic food markets, transportation and access to farm inputs, especially in the developing world, should be expanded.

**CAETS recommends development of better packaging from renewable and sustainable sources worldwide to reduce dependency on fossil resources and reduce food waste and, thus, to reduce environmental impacts associated with food production and distribution.**

### 5. Focus on agro-ecological methods

Agriculture can be intensified through agro-ecological methods using biological and technical knowledge in order to make more effective use of locally available resources and processes. This includes the management of soil fertility, water use and innovative methods for recycling of organic matter and nutrients from farms, food processors and from society. Agro-ecological methods build on improved understanding of biological processes at various levels of scale and profit from ecological, bio-chemical and molecular research methods and from farmers' experience. Contributions from engineers are needed to develop automation and robotic technologies for improved observation and management of crop and livestock health, for control of weeds, reduction of soil compaction and harvest and post-harvest technologies for mixed cropping systems. Such an eco-functional intensification is important for ensuring long-term resilience and productive agriculture in highly intensive regions as well as in food-insecure regions with overly extensive agricultural activity. Agro-ecological methods are the basic principles of organic agriculture and have proven to increase yields, income and food security in Africa and other low input regions. The definition of organic production methods applied in high-income countries should be re-assessed to assure that it is appropriate in developing countries where soil mining is widespread and lack of plant nutrients in the soil is a major barrier to expanded sustainable food production.

**CAETS recommends use of agro-ecological methods as elements in an overall strategy for intensification of food systems based on increased input of biological knowledge and innovative technologies which can improve building of soil fertility, nutrient recycling, water utilization and pest management in synergy with maintenance of biodiversity and ecosystem services; and that knowledge intensive, eco-functional intensification practices should be adapted to local conditions and local farmers' skills.**

### 6. Take political action

Inadequate policies, institutions, and rural infrastructure lead to food systems that do not function efficiently. The prospects for assuring food for all depend, in part, on how governments manage this challenge. Governments should give high priority to rural and agricultural development, infrastructure improvements and enhanced education to advance their level of food self-sufficiency, while preserving their own food culture. Long term growth requires increases in productivity, which involves not only sound markets and property rights regimes, effective and constructive regulation, and appropriately skilled human resources, but also addressing market and information failures, providing public goods, and improving coordination and the diffusion of knowledge and best practices. Good governance is widely acknowledged as an important factor for eradicating poverty and promoting development. Policies and institutions needed to reduce hunger and poverty can be hampered by weak state capacity, mismanagement, and corruption. Poor governance reduces the effectiveness of public and private investment in agricultural infrastructure and services. Good governance recognizes that new market and political reforms will have to consider simultaneously the three important goals of increased food production, reducing hunger and poverty and sustainable management of natural resources. Competition for land use between food production and biomass for energy use must be avoided.

**CAETS recommends that developed and developing countries, international organizations and associations and political unions adopt policy reforms needed to support technical research and financial efforts to secure food for all; and that enlightened governance structures and policies, both locally and globally, are necessary for a more efficient and effective global food system.**

### 7. Establish values on ecosystem services

Food production has important negative externalities, namely effects on the environment or economy that are not reflected in the cost of food. These include the release of greenhouse gases and losses of ecosystem services, which have direct economic repercussions that are systematically underestimated. Future food demands can be met at reasonable prices if environmental externalities are internalized in decisions related to the food system. Payments for ecosystem services can be local up to global. Many threats to biodiversity and ecosystem services can be addressed through robust regulatory frameworks that establish environmental standards and liability regimes. The full costing approach takes both payments for ecosystem services and 'polluter pays' principles into account. It incorporates the social costs of environmental damages as well as the benefits of environmental services into private costs and benefits. The full costing approach is an effective way to assure sustainability. Methods for implementing full costing include taxes such as on $CO_2$ emissions and green taxes like subsidies and payments for ecosystem services. Full costing in the food system will highlight the need for innovation in policy and research together with technology development. There is an urgent need for a better understanding of the effect of globalization on the full food system and its externalities.

**In order to secure the future sustainability of the food system, CAETS recommends political action and government incentives to capture the cost of environmental impacts in the cost of food; and that the resulting revenues should be captured by government and invested to repair damage to natural resources, moving the food system closer to sustainability.**

## CONCLUSION

As addressed by the CAETS 2010 meeting, the world can produce more food and can ensure that it is used more efficiently and equitably. To do so, however, food system stakeholders must focus on solving the central problems associated with securing a sustainable food system – first and foremost, to secure access to plentiful energy at an economical cost through improvements in energy efficiency and use of modern technologies throughout the whole value chain from farm to fork. CAETS suggests that the scaling up and further advancement of innovative approaches already under development will contribute greatly to achieving a sustainable food system and that success will be facilitated if society, industry, public organizations and politicians cooperate to reform and rethink the food system.

On the one hand, the scientific and engineering challenges associated with securing a sustainable food system are immense, but the opportunities to succeed and meet the challenge are great as well. The CAETS academies are committed to bringing their knowledge and skills to help meet the challenge of securing a sustainable food system for the benefit of the world's population.

# CAETS Member Academies

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*www.kvab.be*

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